Testing insurance against illness with health dependent preferences[*]

Aida Galiano[†] Marcos Vera-Hernandez[‡]

21 December 2017

Abstract

The standard test of full insurance assumes that the marginal utility of consumption is invariant to the source of the shock. This is unlikely to hold in the case of illness shocks because preferences might directly depend on health. In this paper, we provide a test of full insurance against health shocks, which circumvents this problem, and apply it to panel data on impoverished rural households in Colombia. Our test rejects that households are fully insured against illness, whereas the standard test that ignores health dependent preferences does not. Our paper also helps to explain why much of the published literature finds that non-medical consumption increases following an illness shock.

1 Introduction

Testing whether households are well insured has been, and remains, a key issue in development economics. Due to malfunctioning or even non-existent

[*]We are grateful to Orazio Attanasio, Emla Fitzsimons, and Mark Rosenzweig for insightful discussions, as well as to participants at the MOVE Development workshop in Barcelona, Household Economics workshop at the Institute for Fiscal Studies, the Royal Economic Society conference special session on Nutrition, and the Applied Microeconometrics Workshop at Oxford University. We thank Soledad Giardili for her excellent research assistance. Any remaining errors are our own. This research was supported by the Economic and Social Research Council via the ESRC-funded Centre for the Microeconomic Analysis of Public Policy (CPP) at the Institute for Fiscal Studies, grant reference ES/H021221/1.

[†]Universidad Internacional de la Rioja (UNIR). E-mail: aida.galiano@unir.net

[‡]University College London and Institute for Fiscal Studies. E-mail: m.vera@ucl.ac.uk

credit and insurance markets, households are not able to fully smooth consumption despite the use of informal risk coping strategies such as transfers, gifts and the sale of assets (Paxson [1992], Rosenzweig and Wolpin [1993a,b], Udry [1994], Townsend [1994, 1995], Besley [1995], Attanasio and Szekely [2004]). In anticipation of this, households might choose inefficient production methods that are less risky, or make sub-optimal investment choices (Rosenzweig and Binswanger [1993], Morduch [1995], Fitzsimons [2007]).

The standard test of whether households are well insured against pure income shocks consists of estimating the relation between consumption growth and income shocks, once aggregate shocks are controlled for (Mace [1991], Townsend [1994]). An implicit but crucial assumption in this test is that the marginal utility of consumption only depends on consumption and not on what triggered the income shock.

Unlike pure income shocks, illness shocks can have a direct effect on the marginal utility of consumption (health-dependent preferences). Our contribution in this paper is to take this into account in testing whether households are fully insured against illness. This is challenging because the one-to-one correspondence between consumption and the marginal utility of consumption no longer holds, and therefore one cannot infer changes in marginal utility from changes in consumption. In particular, and unlike for pure income shocks, a null relationship between non-medical consumption growth and illness shocks does not necessarily imply that the household is fully insured. For instance, if the marginal utility of consumption increased with illness, a well insured household would need to increase consumption by a sufficient amount when affected by illness in order to equate its marginal utility of consumption across the healthy and unhealthy states.

In this paper, we set up a model in which an adult's health influences adult marginal utility directly, but not a child's marginal utility (conditional on the child's consumption). A testable implication of the model is that in well insured households, children's consumption should not depend on adult's health shocks, once aggregate shocks have been controlled for. We take this hypothesis to the data using a three wave panel of impoverished households in Colombia, and test how well households are against health shocks suffered by adult males and adult females. We proxy child's consumption by child's weight, which is particularly apt in developing countries where food represents a large share of consumption. We find that the weight of girls falls following an adult male illness shock, and hence we reject the model's prediction under full insurance. This leads us to conclude that households are insufficiently insured against illness shocks. Interestingly, we fail to find that illness shocks to adult females lead to a decrease in girls' weight, or that the weight of boys decreases following an illness shock of an adult (of either gender). The heterogeneity in our pattern of results helps to dispel possible concerns with our empirical strategy such as omitted variables and illness contagion (see subsection 4.3 for details.)

This paper contributes to an extensive literature testing for full insurance against illness in developing countries, which has implicitly assumed that the marginal utility of consumption does not depend on health. The seminal paper by Gertler and Gruber [2002] found that non-medical household consumption decreased due to the occurrence of illness. However since, a consistent finding emerging from the subsequent literature is that non-medical household consumption does not decrease due to the occurrence of illness. Wagstaff [2007] does not only find that consumption does not decrease with the occurrence of illness, but that some categories of non-medical consumption even increase. Mohanan [2013] finds that households affected by exogenous illness shocks are able to smooth consumption of food, housing, and festivals, with only small reductions in education spending. Islam and Maitra [2012] also find that non-medical consumption increases with health shocks, which is statistically significant in some specifications. Genoni [2012] finds that non-medical consumption increases after illness episodes for higher educated and larger households, although not statistically significant. Jack and Suri [2014] report that household consumption significantly increases following a recent illness episode if the household uses mobile money (which is in line with Low and Pistaferri [2015]'s finding that insured households increase consumption due to disability shocks).[1]

The empirical regularity that non-medical household consumption does not drop (and could even increase) following an illness, could be misinterpreted as meaning that households are fully insured against illness, and hence that health insurance coverage does not need to be expanded further.[2] Using our data, we also replicate this empirical regularity and find that non-medical household consumption also increases following an illness shock, and statistically so depending on the precise empirical specification (which is in line with the findings cited above). However, our model shows that the association between non-medical consumption and illness episodes is uninformative regarding how well insured households are, unless the marginal utility of consumption does not change with health. Although this insight is not new (Gertler and Gruber [2002], Jack and Suri [2014], Low and Pistaferri [2015]),

[1]Jack and Suri [2014] do not interpret this as evidence of full insurance, and they explicitly mention the issue of health-dependent preferences as Gertler and Gruber [2002] do. Low and Pistaferri [2015] find that the marginal utility of consumption increases with illness.

[2]Although health care expenses are not the only loss associated with the occurrence of illness, multiple countries are implementing reforms to expand health insurance amongst poor individuals (Savedoff et al. [2012]). Health insurance reforms are incipient in several countries, for instance, Ethiopia (Alebachew et al. [2014]), Indonesia (The Guardian 2015), and South Africa (Ataguba et al. [2014]). China (Babiarz et al. [2010], Wagstaff and Lindelow [2008], Wagstaff et al. [2009]), Georgia (Bauhoff et al. [2011]), Ghana (Nyonator et al. [2014]), Indonesia (Sparrow et al. [2013]), Mexico (King et al. [2009]), Thailand (Gruber et al. [2014]) and Vietnam (Wagstaff [2010]) began efforts to expand health insurance coverage in the early 2000s, while efforts in India started later in 2008 (Rao et al. [2014]). Earlier on, health insurance expansions efforts had started in Colombia (Trujillo et al. [2005], Miller et al. [2013]), Brazil (Victora et al. [2011]), and Costa Rica (Dow and Schmeer [2003]). Apart from these, community-based insurance schemes expanded in Senegal, India, Tanzania, Mali, Philippines (see Acharya et al. [2013]).

our contribution is to present it alongside the rejection of full insurance, showcasing the potentially misleading conclusions that can be obtained by assuming health-invariant preferences. Hence, we reconcile the evidence that consumption does not decrease due to an illness shock with the rejection of full insurance against illness.

Our paper also contributes to the literature studying how health affects the marginal utility of consumption, which is far from conclusive. Lillard and Weiss [1997] and Low and Pistaferri [2015] find that the marginal utility of consumption increases with illness, while Viscusi and Evans [1990] and Finkelstein et al. [2013] find the contrary, and Evans and Viscusi [1991] and De Nardi et al. [2010] find results that are not statistically different from zero. We find that non-medical consumption increases due to an illness episode. However we cannot deduce from our results that the marginal utility of consumption necessarily increases with illness. This is because some elements of non-medical consumption could also be health enhancing (better foods, cleaner fuel, transportation, etc.) and we would expect them to increase even if the marginal utility of consumption does not increase with illness. Our contribution is to design a test for full insurance that is robust to health-dependent preferences, rather than develop a test that fully identifies the relation between the marginal utility of consumption and illness.

Our paper is also related to a large literature on intrahousehold allocations, and in particular, to papers that test the hypothesis of full risk sharing within the household. Dubois and Ligon [2010] rejects the hypothesis of full insurance within the household, but they focus on pure earnings shocks rather than health shocks. Dercon and Krishnan [2000] finds that the body mass index of poor women decreases if she suffers an illness shock, but they need to assume health-invariant preferences. This is because, unlike us, they assess the consumption of the person who suffers the illness shock.

The consequences of illness shocks, and disability in particular, on household welfare has also been an object of study in developed countries. Using data from either the US or UK, Ball and Low [2014], Meyer and Mok [2013] and Stephens [2001] have analyzed how changes in household consumption are related to disability onset. These reduced form approaches also ignore that preferences are health-dependent (Low and Pistaferri [2015]).[3] We contribute to this literature by proposing a test for insurance that is robust to health-dependent preferences, while keeping to the reduced form approach.[4]

This paper is organized as follows: in section 2, we introduce the Colombian *Familias en Acción* database, and show the empirical regularity that we have mentioned above: non-medical consumption increases (even significantly so depending on the specification) due to an illness shock. In section 3, we provide a model that can simultaneously explains that the association between changes in consumption and illness shocks is uninformative about how well insured household are, as well as provide testable implications of full insurance even if preferences are health-dependent. We devote section 4 to take the model's testable implication to the data: while in 4.1 we lay out empirical approach, we provide the empirical results in 4.2, and dedicate 4.3 to dispel possible concerns with our results. We conclude in section 5. The mathematical derivations are relegated to an Appendix.

2 An empirical regularity

As discussed in the introduction, a series of papers have estimated either a null or positive relationship between changes in non-medical care consumption and illness shocks, using regressions similar to the ones proposed by

[3] See Gallipoli and Turner [2009] and Low and Pistaferri [2015] for structural approaches that incorporate these concerns.

[4] A related literature estimates the effect of health insurance on out-of-pocket medical expenditures and financial strain , see for instance Barcellos and Jacobson [2015], Bernal et al. [2017], Engelhardt and Gruber [2011], Finkelstein and McKnight [2008], Finkelstein et al. [2012], Gross and Notowidigdo [2011], King et al. [2009], Limwattananon et al. [2015], Miller et al. [2013], Shigeoka [2014], Wagstaff and Lindelow [2008], Wagstaff et al. [2009]

Townsend [1994] for income shocks. In this section we will reproduce this common empirical result using a panel of poor households from rural Colombia, the *Familias en Acción (FeA)* database (Attanasio et al. [2003, 2015]). Before reporting the results, we will describe the data.

The *FeA* data were initially collected to evaluate *Familias en Acción*, a conditional cash transfer program modeled after the Mexican PROGRESA/Oportunidades (Beh [2005], Behrman et al. [2009], Gertler [2004], Parker and Todd [2016]). Although in this paper we do not exploit the variability induced by the conditional cash transfer program, we explain the program allocation criteria in order to understand the sample composition. The sample consists of 122 municipalities: 57 treatment municipalities were targeted by *FeA* as of December 2002 and 65 were chosen as comparison municipalities.[5] *FeA* eligible municipalities had less than 100,000 inhabitants, a bank for transferring the money securely, and sufficient education and health infrastructures. The comparison municipalities were chosen as the most similar to the treatment municipalities among those that did not qualify for the program.[6]

Three waves of data have been collected on the same households, the first wave took place between June and October 2002, the second between July and November 2003, and the third between December 2005 and March 2006. Attrition rates were reasonably low (6% between the first and second wave and an additional 10% in the third wave, see Attanasio et al. [2003].)

Typically, health shocks have two implications in terms of household resources: increased medical spending and income loss due to reduced capacity

[5] 13 municipalities that were originally part of the comparison group became treated between November 2003 and December 2005.

[6] Proximity was assessed in terms of population size, percentage of population living in the urban part of the municipality, index of quality of life, and an index measured built using information on health and education infrastructures. In practice, most of the comparison towns satisfied most of the conditions imposed by the program but they did not receive it either because they did not have a bank or because the town mayor did not carry out the required paperwork.

to work. To make sure that we capture the latter, we focus on illness shocks suffered by adult members of the household before they reach retirement age (62 years old for men and 57 for women). We define health shocks using information on whether adults report to have had any health problem during the last fifteen days that prevented them from performing activities of daily living (clearly, the health problem could have started prior to the previous fifteen days). Table 1 reports some basic descriptive statistics about the occurrence of illness shocks. The probability of suffering an illness shock is about 0.16, and very similar for men and women. The transition probabilities reveal that there is some degree of persistence in the illness shock, but less than one would expect from US disability shocks.

Household consumption is estimated using 98 different food items, independently of whether they were purchased, obtained as a gift, obtained as a payment in-kind, or come from their own farm. It also includes information on 51 non-food items such as fuel, transportation, hygiene and cleaning products, clothes and shoes, and durables. Food consumption is measured in the last 7 days as well as other items such as transportation, alcohol, tobacco, and candles. Expenses on personal hygiene, domestic cleaning products, fuel, and leisure activities are measured in the last month, while expenses on clothing, shoes, books and toys are measured in the last three months, as well as medical expenses which are of particular relevance to us. Expenses on durables are recorded in the last 12 months.

Our sample consists of very poor households with children.[7] Average family size is 6.3 and most mothers (58%) have not completed primary education. Most individuals (52%) work in agriculture. Average monthly consumption is about US$180 (US$1=CO$2,600), and the average share of food consump-

[7] Only SISBEN 1 households were part of the sample (SISBEN is a national system of socioeconomic classification in Colombia, SISBEN 1 are the poorest and 6 are the richest.) See Castaneda 2005 for more details on SISBEN.

tion is 64%.[8]

As per other papers cited in the introduction, we estimate the following specification of the Townsend (1994) regression:

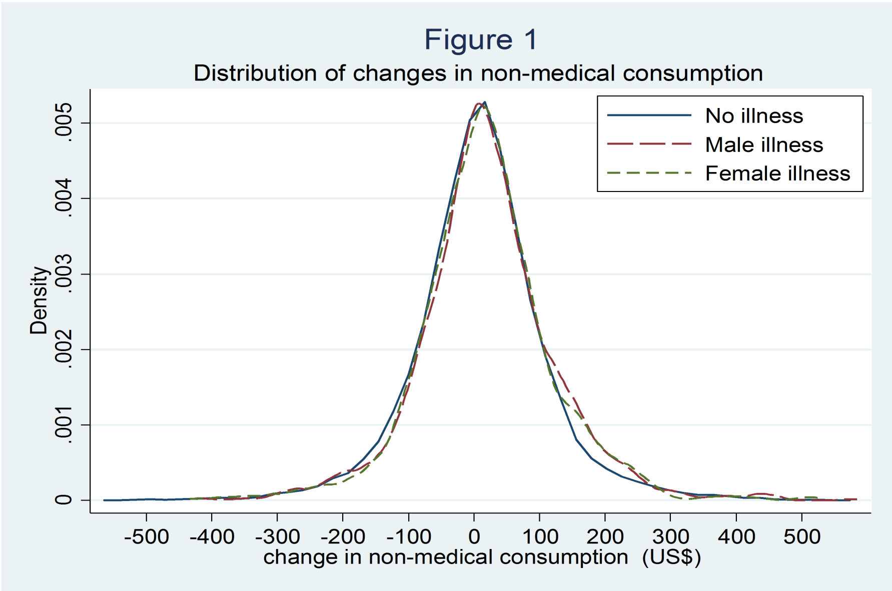
$$\Delta C_{jmt} = \alpha^M \Delta H^M_{jmt} + \alpha^F \Delta H^F_{jmt} + \beta_x \Delta X_{jmt} + \beta_M \Delta M_{jmt} + \theta_{mt} + \varepsilon_{jmt}, \ t = 3, 2, \tag{1}$$

where C_{jmt} is a variable measuring some aspect of the consumption of household j, living in municipality m at time t, H^M_{jmt} (H^F_{jmt}) takes value 1 if a male (female) member aged 18-61 (18-56) of household j living in municipality m was unable to carry out his daily activities due to illness at time t, and takes value 0 otherwise. X_{jmt} are household demographics, and M_{jmt} are dummy variables for the month of the interview. The term θ_{mt} is a municipality-time fixed effect to capture aggregate shocks to the local economy, including the conditional cash program.

Table 2 reports the OLS estimates of α^M and α^F from regression (1) with standard errors clustered at the municipality level to deal with the correlation of the error terms across households of the same municipality, and within households across time periods. Column (1) reports our key result that non-medical consumption increases following a illness shock, that is, the estimates of α^M and $\alpha^F$are positive and statistically different from zero. Figure 1 shows the density of changes in non-medical consumption, and confirms that households that suffered an illness shock have greater mass for consumption changes between \$100 and \$300, and less mass between -\$200 and -\$100.[9]

[8]According to the 2003 Quality Life Survey, the average monthly household consumption in Colombia is US\$432, excluding consumption in kind.

[9]This graph is mainly illustrative because neither demographic changes nor aggregate shocks are being controlled for.



Columns (2) and (3) of Table 2 dissagregate the results in food and non-food non-medical consumption. The point estimates are all positive, and statistically significant, except for the estimate of α^F for food consumption. Column (4) shows that medical expenses increase by very similar amounts (around \$1.25) independently of whether the shock is suffered by a man or woman.

The results are mostly qualitatively similar when we use consumption in logs (columns 5-7), although not always statistically significant. Overall, our results are in line with previous results cited in the introduction that also find that non-medical consumption increases following an illness shock. In light of these results, one might be tempted to conclude that there is little doubt that households are well insured against illness shocks.

An important question is how households could increase consumption if they suffered an illness shock. To explore this, we estimate a variant of regression (1), in which we replace C_{jmt} by a binary indicator related to coping mechanisms (whether the household has positive net transfers, whether the household has positive savings, and whether the household has debts). The results are reported in Table 3, and although not very precisely estimated, they suggest that the probability of positive net transfers (positive savings) increases (decreases) following an illness shock to an adult male, and the probability of having positive debts increases following an illness shock to an adult female.

3 Theoretical model

In this section we derive implications of full insurance that can be tested, and potentially rejected, by the data when preferences are health-dependent. Implications of full insurance are obtained by solving the social planner's problem which maximizes social welfare (represented by the weighted sum of households' utilities) subject to an aggregate resource constraint. We build on the seminal papers by Mace [1991] and Townsend [1994], but importantly we allow for health to change the marginal utility of consumption, and we model households with an adult and child.

We assume that time is finite ($t = 1, ..., T$), and that $t = 0$ corresponds to the initial date. Let u_t be the contemporaneous realization of the random variables (shocks) of the economy at time t, observed at the beginning of period t. Let $s_t = (u_1, ..., u_t)$ represent the history of these realizations, with an ex-ante probability at time 0 given by $\pi(s_t)$. The set of all possible s_t is given by S_t, and hence $\sum_{\tau=1}^{S_t} \pi(s_{t\tau}) = 1$ for any t. The adult member of the household j consumes c_{Ajt} at time t, while the child consumes c_{Cjt} . The adult's health at time t is given by H_{Ajt}, which is part of the stochastic components of the economy.

We assume that the household j's utility function at period t takes the simple form:

$$U[c_{Ajt}, c_{Cjt}, H_{Ajt}] = u_A \left(c_{Ajt}, H_{Ajt}\right) + \lambda u_C \left(c_{Cjt}\right),$$

which assumes that utility is additively separable in adult's and child's consumption, and that adult's health status does not affect the marginal utility of child's consumption (our empirical analysis will shed light on this). Despite the simplicity of the utility function, it allows for adult's health to affect the marginal utility of adult consumption. At time $t = 0$, the household's expected utility is given by:

$$\sum_{t=0}^{T}\beta^t \sum_{s_t \in S_t} \pi(s_t) U[c_{Ajt}(s_t), c_{Cjt}(s_t), H_{Ajt}(s_t)],$$

whereβ $(0 < \beta < 1)$ is the discount factor, and it is explicit that the consumption allocations and adult's health depend on the realization of the history of shocks: s_t.

Our objective is to describe features of the consumption allocations that hold when household j is fully insured, and more generally when markets are complete. For that purpose, and given a set of Pareto-weights $\{w_j\}$,the social planner maximizes the weighted sum of the objective function:

$$\sum_{j=1}^{J} w_j \sum_{t=0}^{T}\beta^t \sum_{s_t \in S_t} \pi(s_t) U[c_{Ajt}(s_t), c_{Cjt\tau}(s_t), H_{Ajt}(s_t)],$$

subject to the following constraints (for each t, and s_t) :

$$\sum_{j=1}^{J} c_{Ajt}(s_t) + \sum_{j=1}^{J} c_{Cjt}(s_t) = \sum_{j=1}^{J} y_{jt}$$

Assuming that the utility functions $u_A(.)$ and $u_C(.)$ take an exponential utility form:[10]

$$u_A(c_{Ajt}, H_{Ajt}) = -\frac{1}{\sigma}\exp(-\sigma(c_{Ajt} + H_{Ajt})), \text{ and}$$

[10]Qualitatively similar results can be obtained using the power utility function with health entering multiplicatively: $u_A(c_{Ajt}, H_{Ajt}) = \frac{1}{\sigma}\exp(\sigma H_{Ajt})(c_{Ajt})^{\sigma}$

$$u_C(c_{Cjt}) = -\frac{1}{\sigma}\exp(-\sigma(c_{Cjt})).$$

The First-Best consumption allocations (derived from the first order conditions of the planner's problem) can be written as

$$c_{Ajt} = \bar{c_{At}} + (H_{Ajt} - \bar{H}_{At}) + \frac{1}{\sigma}(\log\omega_j - \bar{\log}\,\omega), \tag{2}$$

$$c_{Cjt} = \bar{c_{Ct}} + \frac{1}{\sigma}(\log\omega_j - \bar{\log}\,\omega), \tag{3}$$

where $\bar{c_{At}} = \frac{1}{J}\sum_{j=1}^{J} c_{Ajt}$, $\bar{c_{Ct}} = \frac{1}{J}\sum_{j=1}^{J} c_{Cjt}$, $\bar{\log}\,\omega = \frac{1}{J}\sum_{j=1}^{J}\log\omega_j$, and $\bar{H_{At}} = \frac{1}{J}\sum_{j=1}^{J}\log H_{Ajt}$ represent aggregates across households within the economy. Equations (2) and (3) cannot be estimated directly because the Pareto weights are not observable. After taking differences over time and re-ordering, the equations that constitute the basis for the empirical analysis are:

$$c_{Ajt} - c_{Ajt-1} = H_{Ajt} - H_{Ajt-1} - \left(\bar{H}_{At} - \bar{H}_{At-1}\right) + \left(\bar{c}_{At} - \bar{c}_{At-1}\right), \tag{4}$$

$$c_{Cjt} - c_{Cjt-1} = \left(\bar{c}_{Ct} - \bar{c}_{Ct-1}\right). \tag{5}$$

Summing up Equations (4) and (5), we obtain an expression for the change in household consumption, c_{Tjt}:

$$c_{Tjt} - c_{Tjt-1} = H_{Ajt} - H_{Ajt-1} - \left(\bar{H}_{At} - \bar{H}_{At-1}\right) + \left(\bar{c}_{At} - \bar{c}_{At-1}\right) + \left(\bar{c}_{Ct} - \bar{c}_{Ct-1}\right). \tag{6}$$

Equations (4), (5) and (6) provide two main insights. First, the change in adult (and hence household) consumption at time t depends on the change in health status, $H_{Ajt} - H_{Ajt-1}$, even in the First-Best. This is because the marginal utility of adult consumption depends on health. In the First-Best, the marginal utility of consumption is equated across different time periods. If the marginal utility of consumption increases (decreases) with health then more (less) consumption is required to keep the marginal utility of consumption constant when health increases (decreases). This is why the results that we report in Table 2, as well as the results that we cite in the literature, cannot be interpreted as evidence that households are well insured against illness shocks.[11]

Second, the change in child consumption does not depend on changes in adult health. This is for two reasons. First, due to the additive separability assumption, the marginal utility of child consumption does not depend on adult health. Second, we are solving the First-Best problem that assumes complete markets and hence idiosyncratic shocks will not affect consumption allocations unless these shocks affect the marginal utility of consumption. This constitutes our testable implication: if we find that changes in adult health, $H_{Aj,t} - H_{Aj,t-1}$, are related to changes in children consumption, then we would be finding evidence against the model. Under the maintained assumptions that child marginal consumption does not depend on adult health, we would be rejecting the First-Best allocation, and hence full insurance.

Our model does not consider that adult health might depend on the consumption of certain goods (i.e. food, transportation to medical facilities, clean cooking fuel, etc.) that might improve health (Dasgupta [1995], Strauss and Thomas [1998]).[12] This health-enhancing effect of non-medical consumption is an added reason why household non-medical consumption might increase in response to the health shock, even under full insurance. However, this means that we must be cautious to interpret our Table 2 results as unequivocal evidence that the marginal utility of consumption in-

[11]This insight is obviously not new in the literature, but it is useful for us to present it alongside the second insight.

[12]Using a standard household survey, it would be difficult to disentangle what share of the transportation expenses were used to travel to medical facilities, or whether clean cooking/heating fuel is bought to prevent indoor air pollution

creases with illness. Although our results are consistent with it, they could also be explained by a health-enhancing effect of non-medical consumption (and a marginal utility that does not vary with health). Note, though, that because of the separability between the adult and child utility functions, this potential health enhancing effect of consumption will not affect the testable implication of full insurance based on child consumption.

4 Testing for full insurance against health shocks

4.1 Empirical approach

Equations (4), (5) and (6) describe the evolution of consumption if households are fully insured. According to equation (5), the change in child consumption does not depend on idiosyncratic changes in adult health. Hence, full insurance would be rejected if one found that idiosyncratic changes in adult health, $H_{Ajt} - H_{Ajt-1}$, explained changes in child consumption, $c_{Cjt} - c_{Cjt-1}$. Note that the same cannot be said of equations (4) and (6) because idiosyncratic changes in adult's health legitimately explain changes in adult consumption even in the First-Best. This is why we focus on child consumption to test for full insurance against adult health shocks instead of using non-medical household consumption as is standard in the literature.

Because we do not observe directly child consumption, we proxy it using child weight. As is standard, we do not use weight directly but the so-called weight-for-height z-score (WHZ) which represents the standardized difference between the child's weight and the World Health Organization reference population (WHO, 2006).[13] Importantly for us, WHZ varies in the short-run and is the most useful anthropometric indicator for measuring rapid changes in nutritional status (Bairagi [1987], Briend et al. [1989], Brown

[13]The weight-for-height z-score is the difference between a child's weight and the median weight of the WHO reference population of the same height and gender, divided by the standard deviation of the WHO reference population (also of the same height and gender).

et al. [1982], Thomas et al. [1991], Waterlow [1981], WHO [1986]) . For instance, after 7 months of a nutritional intervention, Kenyan children's WHZ increased by 1.19 standard deviations (Tomedi et al. [2012]). Without being part of any specific nutritional intervention but by simply catching-up, WHZ of immigrant boys arriving to the US increased by 0.13 standard deviations in a three month period.[14] Using measurements collected every three months, Briend et al. [1989] find that WHZ is 0.15 standard deviations lower in the lean season in Bangladesh.

We test for full insurance by estimating the empirical counterpart of equation (5), that is:

$$\Delta WHZ_{ijmt} = \gamma^M \Delta H^M_{jmt} + \gamma^F \Delta H^F_{jmt} + \delta_X \Delta X_{jmt} + \delta_M \Delta M_{jmt} + \theta_{mt} + \upsilon_{ijmt}, \; t = 2, 3 \tag{7}$$

where WHZ_{ijmt} is the WHZ of child i, from household j, living in municipality m at time t, υ_{ijmt} is the corresponding error term, and the covariates are defined as in section 2. Also as in section 2, the standard errors are clustered at the municipality level.

4.2 Results

Table 4 reports the OLS estimates of γ^M and γ^F in the sample of children less then 60 months.[15] We find that adult male illness shocks do not change boy's WHZ z-scores, but illness shocks to adult males significantly decrease girls' WHZ z-scores by 0.077, which corresponds to 8.4% of a standard deviation of the sample.[16] Hence, contrary to the implication of equation (5) of our model, we find that changes in child's weight are not only affected by aggregate conditions, but also by idiosyncratic shocks, leading us to reject full insurance

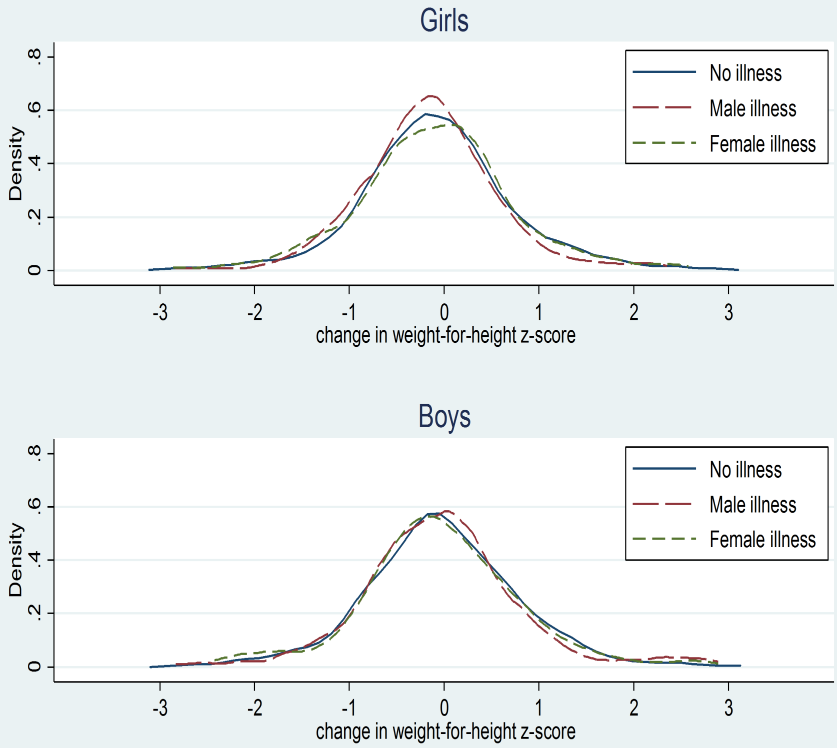
[14] These are our own computations using the data reported in Schumacher et al. [1987]

[15] The weight-for-height z-score is not defined for children who are 60 months or older.

[16] In the sample, the standard deviation is slightly different from 1 because the weight is being standardized using the WHO reference population, instead of the sample distribution. This represents standard practice in the literature.

(and in stark contrast with results from Table 2). We do not find an effect on boys' WHZ z-scores, which might be related to gender bias that is typical in agricultural societies (Behrman and Deolalikar [1990]). These results are confirmed in Figure 2 where it is clear that male illness episodes shift the density of girls' WHZ z-score changes to the left.[17]

Figure 2. Distribution of changes in WHZ z-scores



We do not find evidence that illness shocks to adult females lead to a decrease in children WHZ. The most likely explanation is that household earnings decrease more when the illness shock is suffered by a man than when it is suffered by a woman, simply because women dedicate less time

[17] As with Figure 1, the purpose of this figure is mainly illustrative as it does not control for demographic changes or aggregate shocks.

to market activities in this context. Hence, it is harder for the household to cope financially with illness shocks suffered by adult males, and hence it is more likely that resources are diverted away from children.

4.3 Discussion of possible concerns

The pattern of our results helps us to dispel some concerns with our model and empirical strategy. In the model in section 3, we assume that the adult and child utility function are separable, and that the adult health does not enter directly into the child utility function. If this was not the case, we would expect adult health to enter in equation (5). In that case, a negative coefficient of adult's health on child weight would not necessarily reflect lack of insurance, but an optimal adjustment given that the child marginal utility of consumption would vary directly with adult health. However, for our results in Table 4 to be generated through changes in the child marginal utility of consumption, would require a very specific and unlikely structure of preferences, whereby men's health (but not women's) enters the girls' utility function (but not that of boys'); and that women's health does not enter into boys' utility function either. Note that a similar argument can be made in favor of additive separability between adult and child utility functions.

Another possible concern with our results is that they might be driven by an omitted time-variant variable that leads to endogeneity of changes in adult health in regressions (1) and (7). However, for this to be the case, the time-variant omitted variable would have to be such that it is positively correlated with men's health shocks in the household consumption regression (1), but negatively correlated with it in the girls' WHZ regression (7). Moreover, such a time-variant omitted variable would have to be uncorrelated with women's health shocks. Although not impossible, we find it very difficult to think of a plausible time-variant omitted variable that would lead to such a correlation structure.[18]

As mentioned above, ideally we would have estimated equation (7) using child consumption rather than child weight (WHZ). Because we are using child's weight, our results in Table 4 could be driven by other explanations that would imply that child weight decreases but not child consumption. First, it is plausible that child consumption did not change due to the adult illness shock but child's physical activity increased, leading to a decrease in weight. This could happen, for instance, if the child substitutes for some activity that the male adult used to do. However, this is highly unlikely as all children used in the sample to obtain Table 4 are less than 60 months old, and therefore too young to carry out any physical activity. In Colombia, informal labor market activity does not start generally before 12 years of age, and enrollment in primary school is very high, at over 95%. When the first wave survey questionnaire was being designed, local experts believed it unnecessary to ask about child labor questions to children younger than 10 years old. This was changed in the third wave in which time use was asked for children aged 84 months and older. Table 5 reports the percentage of children aged 84-96 months who are involved in different activities. Even though these children are significantly older than the ones used to estimate Table 4 (84-96 months vs. 59 months or younger), the percentage of children involved in activities such as paid work, and working on the family business is negligible. The only activities in which the young children seem to be significantly involved are domestic activities such as cooking or taking care of siblings. Moreover, women are more likely to be involved in cooking or taking care of children than men, but we find that it is men's illness shocks

[18]Note that an alternative approach would be to instrument health shocks. However, not only it would be difficult to find valid instruments, but the use of instrumental variable would imply that we would be exploiting the predictable/anticipated (rather than unanticipated) variation in health, which it is easier for the household to adjust ex-ante to Jappelli and Pistaferri [2010].

rather than women's that cause the decrease in girls' WHZ. Hence, it is unlikely that our results are caused by increased in physical activity due to task substitution.

Lastly, we want to dispel concerns that the decrease in girls' weight is not due to an illness contagion process, whereby when an adult becomes ill, a child also becomes ill and his/her weight decreases. Again, we can appeal to our pattern of results to rule out this possibility. If illness contagion was underlying our results, we would expect women's illness shocks to also affect child weight, but we do not find evidence of this. Moreover, there is no reason to believe that male illnesses would be more contagious to girls than to boys, which is relevant because we only find evidence of a decrease in girls' weight.

5 Conclusions

We document that much of the empirical evidence reports positive associations between changes in non-medical consumption and illness shocks, which is somehow at odds with the conventional wisdom that health shocks are highly impoverishing in developing countries. However, this positive association between consumption and illness shocks might be due to health-dependent preferences. So far, researchers using reduced form approaches have been forced to assume this problem away by assuming that the marginal utility of consumption does not depend on health.

Building on Mace [1991] and Townsend [1994], we propose a model that allows us to test whether households are well insured against illness shocks, whilst accommodating health-dependence in the utility function. Our testable implication is that child consumption should not depend on adult health shocks, once aggregate shocks have been controlled for. The model is also useful because it makes clear that the relationship between non-medical consumption and illness shocks (and hence the positive association that the literature reports) is uninformative about how well insured households are if preferences are health-dependent.

Using a three wave panel of poor Colombian households, the *Familias en Acción* database, we find two key results, side-by-side. The first result is that we reject that households are fully insured against illness shocks. We find that girls' weight (a proxy for girls' consumption) decreases when male adults suffer an illness shock, which means that we reject our model's testable implication of full insurance. The second key result is that we find, as per the previous literature from developing countries, that non-medical household consumption increases following an illness shock (which is consistent with the marginal utility of consumption increasing with illness). Hence, we reconcile this empirical regularity with the conventional wisdom that illness shocks are impoverishing (as we reject full insurance). This paper not only provides a test for full insurance against illness in the presence of health-dependent preferences, but also cautions against assuming that preferences are health-invariant.

References

Progressing through progresa: An impact assessment of a school subsidy experiment in rural mexico. *Economic Development and Cultural Change*, 54(1):237–275, 2005. ISSN 00130079, 15392988. URL http://www.jstor.org/stable/10.1086/431263.

A. Acharya, S. Vellakkal, F. Taylor, E. Masset, A. Satija, M. Burke, and S. Ebrahim. The impact of health insurance schemes for the informal sector in low- and middle-income countries: a systematic review. *Documento de trabajo sobre investigaciones relativas a políticas de desarrollo*, 1 (WPS6324), 2013.

A. Alebachew, L. Hatt, and M. Kukla. Monitoring and evaluating progress towards universal health coverage in ethiopia. *PLoS Medicine*, 11(9), 2014.

J.E. Ataguba, C. Day, and D. McIntyre. Monitoring and evaluating progress towards universal health coverage in south africa. *PLoS Med*, 11(9), 2014.

O. P. Attanasio and M. Szekely. Wage shocks and consumption variability in mexico during the 1990s. *Journal of Development Economics*, 73(1):1–25, February 2004. ISSN 0304-3878. URL http://www.sciencedirect.com/science/article/pii/S0304387803001275.

O. P. Attanasio, C. Meghir, and M. Vera-Hernandez. Baseline report on the evaluation of familias en accion. *Centre for the Evaluation of Developing Policies. Institute for Fiscal Studies*, 2003.

O. P. Attanasio, V. Oppedisano, and M. Vera-Hernandez. Should cash transfers be conditional? conditionality, preventive care, and health outcomes. *American Economic Journal: Applied Economics*, 7(2):35–52, April 2015. doi: 10.1257/app.20130126. URL http://www.aeaweb.org/articles/?doi=10.1257/app.20130126.

K. S. Babiarz, G. Miller, H. Yi, L. Zhang, and S. Rozelle. New evidence on the impact of china new rural cooperative medical scheme and its implications for rural primary healthcare: multivariate difference-in-difference analysis. *Bmj*, 341:c5617, Oct 21 2010.

R. Bairagi. A comparison of five antropometric indices for identifying factors of malnutrition. *American journal of epidemiology*, 126(2):258–267, 1987.

S. Ball and H. Low. Do self-insurance and disability insurance prevent consumption loss on disability? *Economica*, 81(323):468–490, 2014. ISSN 1468-0335. doi: 10.1111/ecca.12079. URL http://dx.doi.org/10.1111/ecca.12079.

Silvia Helena Barcellos and Mireille Jacobson. The effects of medicare on medical expenditure risk and financial strain. *American Economic Journal: Economic Policy*, 7(4):41–70, nov 2015. doi: 10.1257/pol.20140262.

S. Bauhoff, David R. Hotchkiss, and O. Smith. The impact of medical insurance for the poor in georgia: a regression discontinuity approach. *Health Economics*, 20(11):1362–1378, 2011. ISSN 1099-1050. doi: 10.1002/hec.1673. URL `http://dx.doi.org/10.1002/hec.1673`.

J. R. Behrman and A. B. Deolalikar. The intrahousehold demand for nutrients in rural south india: Individual estimates, fixed effects, and permanent income. *The Journal of Human Resources*, 25(4):665–696, 1990. ISSN 0022166X. URL `http://www.jstor.org/stable/145671`.

J. R. Behrman, S. W. Parker, and P. E. Todd. Schooling impacts of conditional cash transfers on young children: Evidence from mexico. *Economic Development and Cultural Change*, 57(3):439–477, 2009. ISSN 00130079, 15392988. URL `http://www.jstor.org/stable/10.1086/596614`.

N. Bernal, M. A. Carpio, and T. J. Klein. The effects of access to health insurance: Evidence from a regression discontinuity design in peru. *Journal of Public Economics*, 154:122–136, 2017. doi: 10.1016/j.jpubeco.2017.08.008.

T. Besley. Non-market institutions for credit and risk sharing in low-income countries. *The Journal of Economic Perspectives*, 9(3):115–127, 1995.

A. Briend, K. Z. Hasan, K. M. A. Aziz, B. A. Hoque, and F. J. Henry. Measuring change in nutritional status: a comparison of different anthropometric indices and the sample sizes required. *European journal of clinical nutrition*, 43(11):769–778, November 1989.

K. H. Brown, R. E. Black, and S. Becker. Seasonal changes in nutritional status and the prevalence of malnutrition in a longitudinal study of young children in rural bangladesh. *The American Journal of Clinical Nutrition*, 36(2):303–3013, 1982.

Partha Dasgupta. *An Inquiry into Well-Being and Destitution*. Oxford University Press, June 1995. ISBN 978-0-19-828835-0.

M. De Nardi, E. French, and J. B. Jones. Why do the elderly save? the role of medical expenses. *Journal of Political Economy*, 118(1): 39–75, February 2010. ISSN 0022-3808. doi: 10.1086/651674. URL http://dx.doi.org/10.1086/651674.

S. Dercon and P. Krishnan. In sickness and in health: Risk sharing within households in rural ethiopia. *Journal of political Economy*, 108(4):688–727, 2000.

W. H. Dow and K. K. Schmeer. Health insurance and child mortality in costa rica. *Social Science & Medicine*, 57(6):975 – 986, 2003. ISSN 0277-9536. doi: http://dx.doi.org/10.1016/S0277-9536(02)00464-1. URL http://www.sciencedirect.com/science/article/pii/S0277953602004641.

P. Dubois and E. Ligon. Nutrition and risk sharing within the household. CUDARE Working Paper No. 1096, 2010.

Gary V Engelhardt and Jonathan Gruber. Medicare part d and the financial protection of the elderly. *American Economic Journal: Economic Policy*, 3(4):77–102, nov 2011. doi: 10.1257/pol.3.4.77.

W. N. Evans and W. K. Viscusi. Estimation of state-dependent utility functions using survey data. *The Review of Economics and Statistics*, 73(1):94–104, 1991. ISSN 00346535, 15309142. URL http://www.jstor.org/stable/2109691.

A. Finkelstein, E. F. P. Luttmer, and M. J. Notowidigdo. What good is wealth without health? the effect of health on the marginal utility of consumption. *Journal of the European Economic Association*, 11:221–258, 2013. ISSN 1542-4774. doi: 10.1111/j.1542-4774.2012.01101.x. URL http://dx.doi.org/10.1111/j.1542-4774.2012.01101.x.

Amy Finkelstein and Robin McKnight. What did medicare do? the initial impact of medicare on mortality and out of pocket medical spending. *Journal of Public Economics*, 92(7):1644–1668, jul 2008. doi: 10.1016/j.jpubeco.2007.10.005.

Amy Finkelstein, Sarah Taubman, Bill Wright, Mira Bernstein, Jonathan Gruber, Joseph P. Newhouse, Heidi Allen, and Katherine Baicker. The oregon health insurance experiment: Evidence from the first year∗. *The Quarterly Journal of Economics*, $127(3) : 1057 - -1106, jul2012. doi : 10.1093/qje/qjs020$.

E. Fitzsimons. The effects of risk on education in indonesia. *Economic Development and Cultural Change*, 56(1):1–25, October 2007. ISSN 0013-0079. doi: 10.1086/520560. URL http://dx.doi.org/10.1086/520560.

G. Gallipoli and L. Turner. Household responses to individual shocks: Disability and labor supply. Technical report, Nota di lavoro//Fondazione Eni Enrico Mattei: Global challenges, 2009.

M. E. Genoni. Health shocks and consumption smoothing: Evidence from indonesia. *Economic Development and Cultural Change*, 60(3):475–506, 2012. ISSN 00130079, 15392988. URL http://www.jstor.org/stable/10.1086/664019.

P. Gertler. Do conditional cash transfers improve child health? evidence from progresa's control randomized experiment. *The Ameri-*

can Economic Review, 94(2):336–341, 2004. ISSN 00028282. URL http://www.jstor.org/stable/3592906.

P. Gertler and J. Gruber. Insuring consumption against illness. *The American Economic Review*, 92(1):51–70, 2002. ISSN 00028282. URL http://www.jstor.org/stable/3083321.

Tal Gross and Matthew J. Notowidigdo. Health insurance and the consumer bankruptcy decision: Evidence from expansions of medicaid. *Journal of Public Economics*, 95(7-8):767–778, aug 2011. doi: 10.1016/j.jpubeco.2011.01.012.

J. Gruber, N.l Hendren, and R. M. Townsend. The great equalizer: Health care access and infant mortality in thailand. *American Economic Journal: Applied Economics*, 6(1):91–107, January 2014. doi: 10.1257/app.6.1.91. URL http://www.aeaweb.org/articles/?doi=10.1257/app.6.1.91.

A. Islam and P. Maitra. Health shocks and consumption smoothing in rural households: Does microcredit have a role to play? *Journal of Development Economics*, 97(2):232–243, March 2012. ISSN 0304-3878. URL http://www.sciencedirect.com/science/article/pii/S0304387811000484.

W. Jack and T. Suri. Risk sharing and transactions costs: Evidence from kenya's mobile money revolution. *American Economic Review*, 104(1):183–223, January 2014. doi: 10.1257/aer.104.1.183. URL http://www.aeaweb.org/articles/?doi=10.1257/aer.104.1.183.

T. Jappelli and L. Pistaferri. The consumption response to income changes. *Annual Review of Economics*, 2(1):479–506, 2010. doi: 10.1146/annurev.economics.050708.142933. URL http://dx.doi.org/10.1146/annurev.economics.050708.142933.

G. King, E. Gakidou, K. Imai, J. Lakin, R. T. Moore, C. Nall, N. Ravishankar, M. Vargas, M. M. Tellez-Rojo, J. E. Hernandez-Avila, M. Hernandez-Avila, and H. Hernandez-Llamas. Public policy for the poor? a randomised assessment of the mexican universal health insurance programme. *The Lancet*, 373(9673):1447–1454, 2009. ISSN 0140-6736. doi: 10.1016/S0140-6736(09)60239-7. URL `http://dx.doi.org/10.1016/S0140-6736(09)60239-7`.

L. A. Lillard and Y. Weiss. Uncertain health and survival: Effects on end-of-life consumption. *Journal of Business & Economic Statistics*, 15(2):254–268, 1997. ISSN 07350015. URL `http://www.jstor.org/stable/1392309`.

Supon Limwattananon, Sven Neelsen, Owen ODonnell, Phusit Prakongsai, Viroj Tangcharoensathien, Eddy van Doorslaer, and Vuthiphan Vongmongkol. Universal coverage with supply-side reform: The impact on medical expenditure risk and utilization in thailand. *Journal of Public Economics*, 121:79–94, jan 2015. doi: 10.1016/j.jpubeco.2014.11.012.

H. Low and L. Pistaferri. Disability insurance and the dynamics of the incentive insurance trade-off. *American Economic Review*, 105 (10):2986–3029, October 2015. doi: 10.1257/aer.20110108. URL `http://www.aeaweb.org/articles?id=10.1257/aer.20110108`.

B. J. Mace. Full insurance in the presence of aggregate uncertainty. *Journal of Political Economy*, 99(5):928–956, October 1991. ISSN 0022-3808. doi: 10.1086/261784. URL `http://dx.doi.org/10.1086/261784`.

B. D. Meyer and W. K. Mok. Disability, earnings, income and consumption. Working Paper 18869, National Bureau of Economic Research, March 2013. URL `http://www.nber.org/papers/w18869`.

G. Miller, D. Pinto, and M. Vera-Hernandez. Risk protection, service use, and health outcomes under colombia's health insurance program for the poor. *American Economic Journal: Applied Economics*, 5(4):61–91, October 2013. doi: 10.1257/app.5.4.61. URL http://www.aeaweb.org/articles/?doi=10.1257/app.5.4.61.

M. Mohanan. Causal effects of health shocks on consumption and debt: Quasi-experimental evidence from bus accident injuries. *The Review of Economics and Statistics*, 95(2):673–681, may 2013.

J. Morduch. Income smoothing and consumption smoothing. *Journal of Economic Perspectives*, 9(3):103–114, September 1995. doi: 10.1257/jep.9.3.103. URL http://www.aeaweb.org/articles/?doi=10.1257/jep.9.3.103.

F. Nyonator, A. Ofosu, M. Segbafah, and S. dAlmeida. Monitoring and evaluating progress towards universal health coverage in ghana. *PLoS Medicine*, 11(9):e1001691, September 2014. ISSN 1549-1676. URL http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4171378/.

S. W. Parker and P. E. Todd. Conditional cash transfers: The case of progresa/oportunidades. *Journal of Economic Literature, forthcoming*, 2016.

C. H. Paxson. Using weather variability to estimate the response of savings to transitory income in thailand. *American Economic Review*, 82(1), 1992. ISSN 0002-8282.

M. Rao, A. Katyal, P. V. Singh, A. Samarth, S. Bergkvist, M. Kancharla, A. Wagstaff, G. Netuveli, and A. Renton. Changes in addressing inequalities in access to hospital care in andhra pradesh and maharashtra states of india: a difference-in-differences study using repeated cross-sectional surveys. *BMJ Open*, 4(6), June 2014. doi: 10.1136/bmjopen-2013-004471. URL http://bmjopen.bmj.com/content/4/6/e004471.abstract.

M. Rosenzweig and K. I. Wolpin. Credit market constraints, consumption smoothing, and the accumulation of durable production assets in low-income countries: Investments in bullocks in india. *Journal of Political Economy*, 101(2):223–244, 1993a. URL http://www.jstor.org/stable/2138818.

M. R. Rosenzweig and H. P. Binswanger. Wealth, weather risk and the composition and profitability of agricultural investments. *The Economic Journal*, 103(416):56–78, 1993. ISSN 00130133, 14680297. URL http://www.jstor.org/stable/2234337.

M. R. Rosenzweig and K. I. Wolpin. Credit market constraints, consumption smoothing, and the accumulation of durable production assets in low-income countries: Investments in bullocks in india. *Journal of Political Economy*, 101(2):223–244, 1993b. ISSN 00223808, 1537534X. URL http://www.jstor.org/stable/2138818.

W. D. Savedoff, D. de Ferranti, A. L. Smith, and V. Fan. Political and economic aspects of the transition to universal health coverage. *The Lancet*, 380(9845):924–932, 2012. ISSN 0140-6736. doi: 10.1016/S0140-6736(12)61083-6. URL http://dx.doi.org/10.1016/S0140-6736(12)61083-6.

L. B. Schumacher, I. G. Pawson, and N. Kretchmer. Growth of immigrant children in the newcomer schools of san francisco. *Pediatrics*, 80(6):861–868, 1987.

Hitoshi Shigeoka. The effect of patient cost sharing on utilization, health, and risk protection. *American Economic Review*, 104(7):2152–2184, jul 2014. doi: 10.1257/aer.104.7.2152.

R. Sparrow, A. Suryahadi, and W. Widyanti. Social health insurance for the poor: Targeting and impact of indonesia askeskin programme. *Social Science & Medicine*, 96:264–271, November 2013. ISSN 0277-9536. URL http://www.sciencedirect.com/science/article/pii/S0277953612007095.

Melvin Stephens. The long run consumption effects of earnings shocks. *Review of Economics and Statistics*, 83(1):28–36, February 2001. ISSN 0034-6535. doi: 10.1162/003465301750160018. URL http://dx.doi.org/10.1162/003465301750160018.

J. Strauss and D. Thomas. Health, Nutrition, and Economic Development. *Journal of Economic Literature*, 36(2):766–817, June 1998. ISSN 0022-0515. URL http://www.jstor.org/stable/2565122.

D. Thomas, J. Strauss, and M. H. Henriques. How does mother's education affect child height? *The Journal of Human Resources*, 26(2):183–211, 1991. ISSN 0022166X. URL http://www.jstor.org/stable/145920.

A. Tomedi, F. Rohan-Minjares, K. McCalmont, R. Ashton, R. Opiyo, and M. Mwanthi. Feasibility and effectiveness of supplementation with locally available foods in prevention of child malnutrition in kenya. *Public health nutrition*, 15(04):749–756, 2012.

R. Townsend. Risk and insurance in village india. *Econometrica*, 62(3): 539–591, 1994.

R. M. Townsend. Consumption insurance: An evaluation of risk-bearing systems in low-income economies. *The Journal of Economic Perspectives*, 9(3):83–102, 1995. ISSN 08953309. URL http://www.jstor.org/stable/2138427.

A. J. Trujillo, J. E. Portillo, and J. A. Vernon. The impact of subsidized health insurance for the poor: Evaluating the colombian experience using propensity score matching. *International Journal of Health Care Finance and Economics*, 5(3):211–239, 2005. ISSN 1573-6962. doi: 10.1007/s10754-005-1792-5. URL `http://dx.doi.org/10.1007/s10754-005-1792-5`.

C. Udry. Risk and insurance in a rural credit market: An empirical investigation in northern nigeria. *The Review of Economic Studies*, 61(3):495–526, 1994. doi: 10.2307/2297901. URL `http://restud.oxfordjournals.org/content/61/3/495.abstract`.

C. G. Victora, M. L. Barreto, M. do Carmo Leal, C. A. Monteiro, M. I. Schmidt, J. Paim, F. I. Bastos, C. Almeida, L. Bahia, C. Travassos, M. Reichenheim, and F. C. Barros. Health conditions and health-policy innovations in brazil: the way forward. *The Lancet*, 377(9782):2042–2053, 2011. ISSN 0140-6736. doi: 10.1016/S0140-6736(11)60055-X. URL `http://dx.doi.org/10.1016/S0140-6736(11)60055-X`.

W. K. Viscusi and W. N. Evans. Utility functions that depend on health status: Estimates and economic implications. *The American Economic Review*, 80(3):353–374, 1990. ISSN 00028282. URL `http://www.jstor.org/stable/2006671`.

A. Wagstaff. The economic consequences of health shocks: Evidence from vietnam. *Journal of Health Economics*, 26(1):82–100, January 2007. ISSN 0167-6296. URL `http://www.sciencedirect.com/science/article/pii/S0167629606000737`.

A. Wagstaff and M. Lindelow. Can insurance increase financial risk?: The curious case of health insurance in china. *Journal of Health Economics*, 27(4):990–1005, July 2008. ISSN 0167-6296. URL `http://www.sciencedirect.com/science/article/pii/S0167629608000052`.

A. Wagstaff, M. Lindelow, G. Jun, Xu Ling, and Qian Juncheng. Extending health insurance to the rural population: An impact evaluation of china's new cooperative medical scheme. *Journal of Health Economics*, 28(1):1–19, January 2009. ISSN 0167-6296. URL http://www.sciencedirect.com/science/article/pii/S0167629608001392.

Adam Wagstaff. Estimating health insurance impacts under unobserved heterogeneity: the case of vietnam's health care fund for the poor. *Health Economics*, 19(2):189–208, 2010. ISSN 1099-1050. doi: 10.1002/hec.1466. URL http://dx.doi.org/10.1002/hec.1466.

J. C. Waterlow. Observations on the suckling dilemma personal view. *Journal of Human Nutrition*, 35(2):85–98, 1981.

WHO. Use and interpretation of anthropometric indicators of nutritional status. *Bulletin of the World Health Organization*, 64(6):929, 1986.

Appendix

In this Appendix, we derive equations (5) and (6) of the model. The social planner maximizes

$$\sum_{j=1}^{J} w_j \sum_{t=0}^{T} \beta^t \sum_{s_t \in S_t} \pi(s_t) U[c_{Ajt}(s_t), c_{Cjt}(s_t), H_{Ajt}(s_t)],$$

subject to the following constraints :

$$\sum_{j=1}^{J} c_{Ajt}(s_t) + \sum_{j=1}^{J} c_{Cjt}(s_t) = \sum_{j=1}^{J} y_{jt}$$

We assume that the utility functions $u_A(.)$ and $u_C(.)$ take an exponential utility form:[19]

[19]Qualitatively similar results can be obtained using the power utility function with health entering multiplicatively: $u_A(c_{Ajt}, H_{Ajt}) = \frac{1}{\sigma}\exp(\sigma H_{Ajt})(c_{Ajt})^{\sigma}$

$$u_A(c_{Ajt}, H_{Ajt}) = -\frac{1}{\sigma}\exp(-\sigma(c_{Ajt} + H_{Ajt})), \text{ and}$$

$$u_C(c_{Cjt}) = -\frac{1}{\sigma}\exp(-\sigma(c_{Cjt})).$$

Hence, the Lagrangian of the maximization program (where we omit that the consumption allocations depend on(s_t) for convenience) is:

$$L =$$

$$\sum_{j=1}^{J} w_j \sum_{t=0}^{T} \beta^t \sum_{s_t \in S_t} \pi(s_t)[-\frac{1}{\sigma}\exp(-\sigma(c_{Ajt} + H_{Ajt})) - \frac{\lambda}{\sigma}\exp(-\sigma(c_{Cjt}))]$$
$$-\sum_{t=0}^{T} \mu_t \left(\sum_{j=1}^{J} c_{Ajt} + \sum_{j=1}^{J} c_{Cjt} - \sum_{j=1}^{J} y_{jt} \right)$$

The first order condition for the child's consumption allocation is:

$$w_j \beta^t \pi(s_t)\lambda \exp(-\sigma(c_{Cjt})) - \mu_t = 0.$$

Hence, the optimal allocation satisfies:

$$w_j \exp(-\sigma(c_{Cjt})) = \frac{\mu_t}{\beta^t \pi(s_t)\lambda}.$$

Taking logs and re-arranging terms:

$$c_{Cjt} = \frac{lnw_j}{\sigma} - \frac{1}{\sigma} ln(\frac{\mu_t}{\beta^t \pi(s_t)\lambda}) \tag{8}$$

Aggregating over j, we obtain:

$$\overline{c}_{Ct} = \frac{1}{\sigma}\overline{w} - \frac{1}{\sigma} ln(\frac{\mu_t}{\beta^t \pi(s_t)\lambda}), \tag{9}$$

where $\overline{c}_{Ct} = \frac{1}{J}\sum_{j=1}^{J} c_{Cjt}$ and $\overline{w} = \frac{1}{J}\sum_{j=1}^{J} lnw_j$ represent economy wide averages. After substituting $-\frac{1}{\sigma} ln(\frac{\mu_t}{\beta^t \pi(s_t)\lambda}) = \overline{c}_{Ct} - \frac{1}{\sigma}\overline{w}$ in (8), we obtain:

$$c_{Cjt} = \overline{c}_{Ct} + \frac{lnw_j}{\sigma} - \frac{1}{\sigma}\overline{w}.$$

Note the last two terms are time invariant, hence after taking differences over time, we obtain:

$$c_{Cjt} - c_{Cjt-1} = \overline{c}_{Ct} - \overline{c}_{Ct-1}, \tag{10}$$

which corresponds with our testable implication, equation (5).

To study the adult's optimal allocations, we obtain the first order conditions with respect to c_{Ajt}. The first order condition with respect to c_{Ajt} is

$$w_j \beta^t \pi(s_t) \lambda \exp(-\sigma(c_{Ajt} + H_{jt})) - \mu_t = 0, \tag{11}$$

which follows quite closely the child's consumption allocation, except for the fact that health also enters in the marginal utility of consumption. Rearranging (11) and taking logs, we obtain:

$$ln w_j - \sigma(c_{Ajt} + H_{jt}) = ln(\frac{\mu_t}{\beta^t \pi(s_t)\lambda}),$$

that is:

$$c_{Ajt} = \frac{ln w_j}{\sigma} - H_{jt} - \frac{1}{\sigma} ln(\frac{\mu_t}{\beta^t \pi(s_t)\lambda}), \tag{12}$$

Aggregating over j, we obtain:

$$\frac{1}{J}\sum_{j=1}^{J} c_{Ajt} = \frac{1}{J}\sum_{j=1}^{J} \frac{ln w_j}{\sigma} - \frac{1}{J}\sum_{j=1}^{J} H_{jt} - \frac{1}{\sigma}\frac{1}{J}\sum_{j=1}^{J} ln(\frac{\mu_t}{\beta^t \pi(s_t)\lambda}),$$

that is

$$\overline{c}_{At} = \frac{1}{\sigma}\overline{w} - \overline{H}_t - \frac{1}{\sigma} ln(\frac{\mu_t}{\beta^t \pi(s_t)\lambda}),$$

where $\overline{c}_{At}$, $\overline{H}_t$ represent economy wide averages ($\overline{c}_{At}$=$\frac{1}{J}\sum_{j=1}^{J} c_{Ajt}$, and $\overline{H}_t$ =$\frac{1}{J}\sum_{j=1}^{J} H_{jt}$). Substituting $-\frac{1}{\sigma}ln(\frac{\mu_t}{\beta^t\pi(s_t)\lambda})$=$\overline{c}_{At} - \frac{1}{\sigma}\overline{w} + \overline{H}_t$ in (12), we obtain:

$$c_{Ajt} = \frac{ln w_j}{\sigma} - H_{jt} + \overline{c}_{At} - \frac{1}{\sigma}\overline{w} + \overline{H}_t.$$

After taking differences over time, the time constant terms cancel out yielding:

$$c_{Ajt} - c_{Ajt-1} = -H_{jt} + H_{jt-1} + \bar{c}_{At} - \bar{c}_{At-1} + \overline{H}_t - \overline{H}_{t-1},$$

that is

$$\triangle c_{Ajt} = -\triangle H_{jt} + \triangle \bar{c}_{At} + \triangle \overline{H}_t.$$

which, combined with (10), yields the evolution for total household consumption (equation 6):

$$\triangle c_{Ajt} + \triangle c_{Cjt} = -\triangle H_{jt} + \triangle \bar{c}_{At} + \triangle \bar{c}_{Ct} + \triangle \overline{H}_t.$$

Table 1. Descriptive statistics of illness events

	Male Adult	Female Adult
Prob (ill_{it}=1)	0.164	0.157
Prob (ill_{it}=1|ill_{it-1}=1)	0.265	0.258
Prob (ill_{it}=1|ill_{it-1}=1,ill_{it-2}=1)	0.359	0.305
Number of observations	22,302	22,679

Notes: The variable ill takes value 1 if the individual reports individuals report to have had any health problem during the last fifteen days that prevented him/her from performing activities of daily living, and 0 otherwise. The individuals included in the sample have worked for pay at least once in their lives. Males are 18-61 years old, and females are 18-56 years old. Number of observations refer to those used in computing the first row.

Table 2. Consumption and adult illlness shocks

VARIABLES	(1) Non-medical consumption	(2) Non-medical non-food consumption	(3) Food consumption	(4) Medical care expenses	(5) **LN** (Non-medical consumption)	(6) **LN** (Food consumption)	(7) **LN** (Non-medical non-food consumption)
Δ illness (adult male)	4.890**	2.096**	2.688*	1.276***	0.021**	0.018	0.021
	[1.977]	[1.002]	[1.463]	[0.260]	[0.010]	[0.014]	[0.016]
Δ illness (adult female)	4.351**	2.852***	0.678	1.188***	0.014	-0.006	0.038***
	[1.874]	[1.010]	[1.394]	[0.263]	[0.010]	[0.013]	[0.014]
Mean	186.0	61.32	121.3	4.372	5.094	4.637	3.849
Observations	11,816	11,923	11,848	11,918	11,816	11,848	11,914

Notes: Each column reports the results of a different OLS regression. The dependent variable is the change in the variable specified in the column heading, measured in US$ (US$1= CO$2,600). The right hand side variables are change in male illness, change in female illness, changes in the number of children aged 0-5, 6 to 11, 12-17 living in the household, as well as the change in the number of adult men and women, and changes in dummy variables for month of interview. All regressions include municipality-wave fixed effects. Standard errors, reported in brackets, are clustered at the municipality level. *** p<0.01, ** p<0.05, * p<0.1

Table 3. Coping mechanisms and adult illness shocks

VARIABLES	(1) Net positive Transfers	(2) Positive Debts	(3) Positive Savings
Δ illness (adult male)	0.026*	0.009	-0.008*
	[0.013]	[0.009]	[0.005]
Δ illness (adult female)	0.017	0.022*	-0.003
	[0.013]	[0.011]	[0.005]
Observations	11,976	11,976	11,976

Notes: Each column reports the results of a different OLS regression. The dependent variable is the change in the variable specified in the column heading. The right hand side variables are change in male illness, change in female illness, changes in the number of children aged 0-5, 6 to 11, 12-17 living in the household as well as the change in the number of adult men and women, and changes in dummy variables for month of interview. All regressions include municipality-wave fixed effects. Standard errors, reported in brackets, are clustered at the municipality level. *** p<0.01, ** p<0.05, * p<0.1

Table 4. Children's weight-for-height z-score and adult illness shocks

VARIABLES	(1) Boys' WHZ	(2) Girls' WHZ
Δ illness (adult male)	0.023	-0.077**
	[0.034]	[0.030]
Δ illness (adult female)	-0.032	0.020
	[0.042]	[0.043]
Mean	-0.0701	-0.0689
SD	0.868	0.920
Observations	2,593	2,451

Notes**:** Each column reports the results of a different OLS regression. The dependent variable is the change in the child weight-for-height z-score. The right hand side variables are change in male illness, change in female illness, changes in a cubic polynomial of child's age, changes in the number of children aged 0-5, 6 to 11, 12-17 living in the household, as well as the change in the number of adult men and women, and changes in dummy variables for month of interview. All regressions include municipality- survey wave fixed effects. Standard errors, reported in brackets, are clustered at the municipality level. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Percentage of children aged 84-96 months engaged in different activities

	Boys	Girls
Paid work	0.00%	0.16%
Unpaid work		
Helping in the family field / taking care of animals	5.45%	3.13%
Cooking/taking care of children/domestic chores	24.58%	34.53%
Working on the family business at home	0.28%	0.31%
Other	0.56%	0.62%

Note: The table reports the percentage of children that participated in each activity in the last working day prior to the day of the interview. Information only available for the third wave of the panel.